

DIAMOND HEAD AND WAIKIKI BEACH



SURF RIDING AT WAIKIKI

HAWAIIAN ISLANDS

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MENTOR GRAVURES—STATUE OF KAMEHAMEHA,
HONOLULU · PALACE, HONOLULU · WAIKIKI
BEACH · RESIDENCE OF QUEEN LILIUOKALANI,
HONOLULU · A SEA COAST SCENE, HAWAII · HELL'S
KITCHEN, VOLCANO OF KILAUEA



MARK TWAIN once said that the Hawaiian group was "the loveliest fleet of islands anchored in any ocean." Conjure up a memory of a perfect May day, when sunshine, soft air and smiling Nature combine to make the heart glad, then multiply that day by three hundred and sixty-five, and the result is a round year of Hawaii. The Hawaiian Islands are semi-tropical, radiant and beautiful, full of the life and spirit of the United States. We discover there an intense Americanism, a people as patriotic as are those in any State of the Union.

It is a journey of five days from our Western coast before one hears the cry, "Diamond Head is in sight." From the deck of the steamer one looks upon the protruding nose of the Island of Oahu, which though not the largest island in the group, has the greatest number of inhabitants and contains the largest city. From an extinct crater rising

abruptly above the city, known as the Punch Bowl, one obtains his best view of the capital of the islands. It is a flower-embowered metropolis, where every house is surrounded by foliage, trees and floral beauty.

Honolulu

Fort Street, the principal business thoroughfare of Honolulu, reminds one strongly of a street in one of our prosperous Western cities. The buildings are typically American in style of architecture, and the shops are modern and up-to-date. Many of the larger stores would be a credit to any of our metropolitan cities.

Hawaii is the melting-pot of the Pacific—nowhere else is there a more curious or polyglot population. On May Day there is an assemblage of children to celebrate the coming of spring. Upon this occasion one may see representatives of almost every nation, and types representing a mixture of the blood of many nationalities.

Honolulu has many beautiful homes. The old-style house, built in the Colonial style, with a double-porch front, is gradually disappearing. In its place sugar barons are erecting mansions, such as one might expect to see at Newport, Rhode Island, or at Pasadena, California. Magnificent grounds surround many of these palatial residences.



THE PALI
The famous pointed peak near Honolulu

Yesterday and Today

Kamehameha was the first to unite the islands under one head. Soldier and warrior, Kamehameha ruled despotically but wisely, and he is today worshiped by the descendants of the early inhabitants.

The little opera bouffe kingdom succumbed to the law of destiny in 1898, when the reigning queen was deposed.

Surrounded by a beautiful park, the old palace is intact, and occupies one of the most conspicuous locations in the city. Here in former days reigned King Kalakaua, and later Queen Liliuokalani, and all the etiquette, all the form and ceremony that obtained in the royal houses of Europe were observed here.

Of the old régime there remains only the deposed Queen Liliuokalani, living out the eventide of an eventful life in the home built by her husband, the Prince Consort. The house is filled with relics of the days of

royalty. On Hawaiian holidays, on her birthday, and on other occasions she still receives in semi-royal state. Guests are ushered into her drawing-room by the same officer who officiated as chamberlain during her reign. Her attendants are the same women that attended her in the days of the monarchy. Behind her throne may still be seen the old silken royal standard of Hawaii. The Hawaiian people appropriate every year in the legislature a sum of \$15,000, so that the Queen may pass her declining days in comparative comfort.

Society still has its royal set, among whom is Prince Cupid, the representative of the islands in our national House of Representatives in Washington. His home is frequently the scene of brilliant functions, and in the quaint little Hawaiian hut, conspicuously placed on the lawn, the Prince and Princess often serve tea, and society gathers to partake of unusual hospitality.

When the Hawaiian kings held high festival in the old days, princesses of royal blood, representing the four chief islands, appeared in the retinue of the monarch. Each wore a flowing pau or long skirt, the colors denoting the rider's island. Today these pau riders appear in pageants in reproduction of the garlanded pomp of the island monarchy.

In former days royalty was entertained by hula dances. Beautiful young women were chosen for the dance, but in recent years it has degenerated into a vulgar exhibition. There is nothing objectionable when the hula is properly danced, as it is purely native, and in its rhythm and music typically Hawaiian.

There is much of beauty to be found in the purely native type. We observe it in the well-rounded features, in large, luminous and lustrous eyes, and in the rich, light brown complexion. At one time there were more than 200,000 natives; today there are less than 40,000, and of that number many have intermarried with other races; it is therefore evident that the Hawaiians are a passing race.



DATE PALM DRIVE, HONOLULU



FORT STREET, HONOLULU
Principal business street of that city

More than one hundred years ago missionaries were at work in the islands, and through their efforts many of the natives were converted to Christianity. The first church to be built by the missionaries still stands as a reminder of the early days. It was built of coral blocks, cut from the reef outside the harbor, and on Sunday morning services are still conducted in the native dialect in the old coral church.

Among some of the wealthiest and most prominent families on the Island of Oahu are descendants of the early missionaries. One of the finest buildings in Honolulu is the Bishop Museum, which was presented to the city by the Bishop family, whose forebears were missionaries. The museum is filled with interesting relics that afford a visible history of the islands.



ROYAL HAWAIIAN HOTEL, HONOLULU

Beauty Spots

In attempting to describe the floral beauty of Hawaii one feels that there is something lacking in the English language. Ordinary adjectives will not adequately describe what one sees. If one had pointed out to him a single flower he might find words to express his appreciation, but when without previous warning a whole hedge of night-blooming cereus is thrust upon him, he simply gasps for adequate words.

A golf player would be amply repaid if he traveled all the way to Honolulu for the privilege of playing golf on one of the most beautiful links in the world. Surrounding the Country Club is an eighteen-hole course, beautifully laid out, half by nature and half by man. With a perfect climate, and a fine course, every day a May day, playing is an enjoyable privilege.

In Kapiolani Park is the famous aquarium, filled with "impossible fish," so called because they are so gorgeously colored that it does not seem possible that they can be real. Near the park is Waikiki (wei*-kee'-kee), an all-the-year round bathing



OLD CORAL CHURCH, HONOLULU

*ei as in height.



FINE PRIVATE RESIDENCE, HONOLULU

resort, where the water throughout the year is usually at a temperature of 70°. It is a most delightful place of its kind, tempting visitors from all parts of the world.

Waikiki Beach

Along the beach, which stretches for some distance, are numerous villas and hotels. A prettier spot could not be found.

Hawaiian mermaids make their homes upon the soft sands of Waikiki. Marvelous swimmers are these native

girls; like human fish they surmount the huge breakers that roll in over the coral reefs. The Hawaiian children, clad only in innocence, are a joy to see. They learn to swim before they are old enough to think, and they play through the surf in laughing sport like children of the waves.

Surf-board riding is the most thrilling sport at Waikiki. Picking out a "comber," as the riders call it, they fling themselves astride their surfboards; balancing themselves and standing erect, they ride at lightning speed on the crest of the enormous roller. Like winged Mercury they seem fairly to fly over the water. One experiences many thrills and sees many spills. Although women participate as well as men, it is a sport for the sturdy, not for the timid.

Equally popular at Waikiki is riding in out-rigger canoes, and these boats also require skill in handling, as they are easily overturned. There are many exciting races by crews consisting of natives who are pitted against American crews. When our thoughts dwell on the Island of Oahu, Waikiki comes readily to mind in memories of sunbathed days and moonlit nights, when we sat on the beach listening to the tinkle and strum of the ukelele, the sad but melodious songs of the Hawaiians, and passed the hours as if in dreamland.

Pali, the Precipice

No place on the Island of Oahu is more familiar than the Pali, a word that is Hawaiian for precipice. It is surmounted by a curious cone-shaped peak, that lures us from the city below to the edge. We come suddenly upon the rim and look down



MCKINLEY HIGH SCHOOL, HONOLULU

1,300 feet to the floor of the valley, which is on the other side of the island.

Pineapples, Rice and Sugar

We may motor from the Pali over a splendid road down the side of the mountain and continue all the way round the island, making the circuit and returning to Honolulu. High above us are the bleak and barren summits of the mountain range which divides the island, while about us are cultivated fields of great fertility. Covering the undulating hills are pineapple plantations.

As a rule pineapples are picked when they are still green, but not in Hawaii. There they are permitted to ripen, as they are taken directly from the fields to the pineapple cannery. In 1901 but two thousand cases of pineapples were canned and sent to the United States, but so has the industry grown that last year there was a total of about 2,500,000 cases shipped to the United States. Last year the value of the crop approached \$5,000,000. Within the factory are machines which with one movement peel, core and cut the end off the fruit, after which it is forced against a set of knives which slice it to the desired thickness. It is then carried along an endless belt and dropped into tins, where it is sealed, made airtight and dustproof.

A railroad has been completed which now extends about half way around the island. The look-out-for-the-car warnings are printed in three languages—Hawaiian, Japanese and English, another evidence of the polyglot nature of the population.

One motors past a panorama of scenic grandeur which continues mile after mile. Here and there the mountains are indented by valleys, all of which are accessible by motor, but through one valley we must walk; it is so narrow that a road is impossible. We therefore abandon our motor car and walk for about two hours amid superb scenery. At the terminus of the valley we come upon the sacred falls, one of the prettiest in this semi-tropical paradise.

It is on this side of the island that we come upon Haleiwa, where the



THRONE ROOM IN PALACE, HONOLULU

This room is retained in the same condition as when King Kalakaua and Queen Liliuokalani ruled. The building is now occupied by the Government



ENTRANCE TO THE AQUARIUM, HONOLULU

H A W A I I

Hawaiians go for a rest. It is a delightful resort. Here one may motor over splendid roads, enjoy swimming, fishing, walking, and golf and comfortable hotel life. The semi-tropical climate is not suitable for the cultivation of such cereals as wheat and corn; we therefore find vast fields of rice. There is an embargo on the shipment to the United States of anything but canned fruit and sugar, as we do not want to import semi-tropical insects, which might be a menace to our crops, so everything else grown on the island must be consumed there.

Fields of waving cane call attention to the greatest of all industries in Hawaii, that of sugar-growing and refining. More than one hundred millions of dollars have been invested in sugar mills and plantations. The production of sugar is limited by the labor supply. Since the Chinese have been excluded, the great problem that has confronted the sugar planters is obtaining sufficient labor. Refineries dot the landscape, but until the time comes when a sufficient supply of labor can be obtained,

the sugar industry has gone about as far as it can.

Inter-island steamers ply between the various islands, and afford excellent service. The boats are not large, and the distance is at no times great, and yet in crossing the channels one may experience all the terrors of the English Channel in rough weather.

Kauai and Maui Islands

One of the most attractive of the islands is in the northern group, and although one of the smallest, it is a scenic gem. Few tourists go to Kauai, because of its



COUNTRY CLUB AND GOLF LINKS, HONOLULU



HOTEL AND GARDENS, HALEIWA
Across the Island of Oahu from Honolulu

inaccessibility, but for those who have the time and sufficient wanderlust to endure fatiguing climbs, Kauai offers some of the finest mountain scenery on the islands.

Native life is primitive; here we still find straw huts and see the natives in their original state. Government schools are bringing the children into closer touch with civilization, but the older generation are today as they were before annexation.

Huge cracks indicate that at one time there must have been a violent upheaval of nature, which split in twain the range of mountains intersecting the island. Splendid canyons extend across the center of the island. These gorges are very deep, and are painted by nature in many colors. At the base of the principal canyon is a raging torrent. We follow the rim for many miles, and returning to the seashore go on board another steamer, which transports us south to the Island of Maui.

Maui is one of the larger islands, and like the others, is covered with mountains. On this island is one of the largest extinct craters in the world, that of Haleakala. Standing on its rim we may look across seven miles to the opposite side, and in the intervening distance see a number of huge cinder cones.

On the precipitous side of the cliffs are caves, which were once used as burial places by the natives. They have long since been abandoned, but remain as interesting memorials.

Upon the Island of Molokai is the leper settlement, which recalls the martyrdom of Father Damien. Life there has been greatly improved. The settlement is now well managed—all its arrangements being conducted in thoroughly scientific and humane manner.

Island of Hawaii

Coconut Isle marks the entrance to the bay of Hilo in the Island of Hawaii, the largest island in the group. On this island is the only tame volcano in captivity. Hilo, the seaport, is the second largest city on the



HULA HULA GIRLS

Hawaiian girls with ukeleles, ready for the dance. From an old photograph taken in the days of King Kalakaua



RAINBOW FALLS

Situated about four miles from Hilo, Island of Hawaii

islands, a town of about 10,000 inhabitants. It contains 800 automobiles, and in addition boasts of a splendid hotel. A few miles distant are the Rainbow Falls, and another interesting excursion is over the Hilo railroad, where one may enjoy two hours of scenery unsurpassed for beauty.

In the lowlands of the Island of Hawaii are many paddy or rice fields. Wherever one finds rice growing he is sure to come upon Japanese. The Japanese now compose one-third of the total population of the islands.

Some of the finest sheep ranches are also to be found on this island, and probably nowhere on earth would one see such a curious assortment of farm hands, and hear as many different languages spoken as upon one of these Hawaiian ranches.



KALAKAUA AND ROBERT LOUIS STEVENSON

This photograph of the former king and the celebrated author was taken in Honolulu about 1889

From Hilo a fern-fringed road leads to the volcano, thirty miles distant. One may motor all the way, or go by train to within nine miles of the crater, but the motor ride is by all means preferable, especially if one is in search of novel and unusual sights.

Kilauea Volcano

From the veranda of the Volcano House, one may see, rising from the crater of Kilauea, dense clouds of smoke, steam and sulphur fumes. In the intervening space are barren fields of lava rock, seven miles of dead, burned out cinder, absolutely arid, utterly desolate.

Formerly one went by horse over the trail which leads to the crater, but now a motor car takes one to the brink in less than half an hour. It is a weird, almost uncanny, experience to travel over the gnarled and knotted surface of lava rock. Cracked and broken, twisted into every conceivable shape, this dead mass continues for miles.

Over this scene of desolation a motor road has been built, and one may now park his car within a few



MAKAHUENA, ISLAND OF KAUAI

The old time picturesque grass huts have given way to crude wooden cottages

feet of the brink. With grinding brakes we move on. Darting through clouds of steam, assailed by choking whiffs of sulphur fumes, we begin to realize our nearness to the crater. Tourists usually hurry to Hell's Kitchen, where they scorch postal cards in the crevices, but they do not remain long; the sulphur fumes are too much for them.

Approaching the brink, we shade our eyes from the heat and look down into Halemaumau, "The House of Everlasting Fire." Hundreds of feet below is a bubbling, seething pool of boiling lava, a living fire, two hundred feet in width and seven hundred feet in length.

Spray showers of molten rock and burning gas leap to a height of seventy feet or more, making a roar louder than the mightiest surf that beats on rockbound shores. Some months ago the surface of the burning lake dropped two hundred feet, and since then it has grown in activity from day to day.

At night the volcano takes on new life, and then we appreciate anew its awe-inspiring grandeur. Luminous streaks appear in every direction,



PINEAPPLE PLANTATION, ISLAND OF HAWAII

The earth, to all appearances, has just had a close hair cut!



THE PINEAPPLE GROWS HIGH IN HAWAII

giant flaming fingers rend the inky surface like the forks of chain lightning. Ever widening, the cracks extend until the whole mass bursts, throwing jets of golden lava high in the air. Leaping, writhing rockets of liquid fire hiss through the air, spreading showers of glowing sparks.



RICE FIELD NEAR HONOLULU



FIELD OF TWISTED LAVA, KILAUEA VOLCANO, HAWAII

Far below, huge sections swirl and are tossed about in the currents, like corks on an ocean wave. Turning end up, they roll over and convert themselves into seething furnaces, cauldrons of bubbling gold. Here is a workshop that has been running a double shift since the dawn of time. This is not a fire that consumes itself, but an ever-living, unquenchable thing, burning a melting world. In 1912, the lava rose to within sixty feet of the top, and during the same year sank suddenly one thousand feet in a space of twenty-four hours. An everlasting struggle is going on between the exterior and interior forces of the earth. From this dragon's mouth rises a flood of scarlet flame, illuminating the heavens, casting a living glow of red on the edge of a visible Hades.

It is hard to impart in words the charm that casts its spell upon the visitor to these garden lands of the Summer Sea. Add to climatic condi-

tions a group of islands of scenic splendor and carpeted with beautiful flowers, and on one of these islands place the most wonderful of active volcanoes—and you have some idea of this paradise of the Pacific.

SUPPLEMENTARY READING

HAWAII, PAST AND PRESENT

By W. R. Castle

HAWAIIAN LEGENDS OF VOLCANOES

By W. D. Westervelt

THE STORY OF HAWAII

By M. C. Alexander

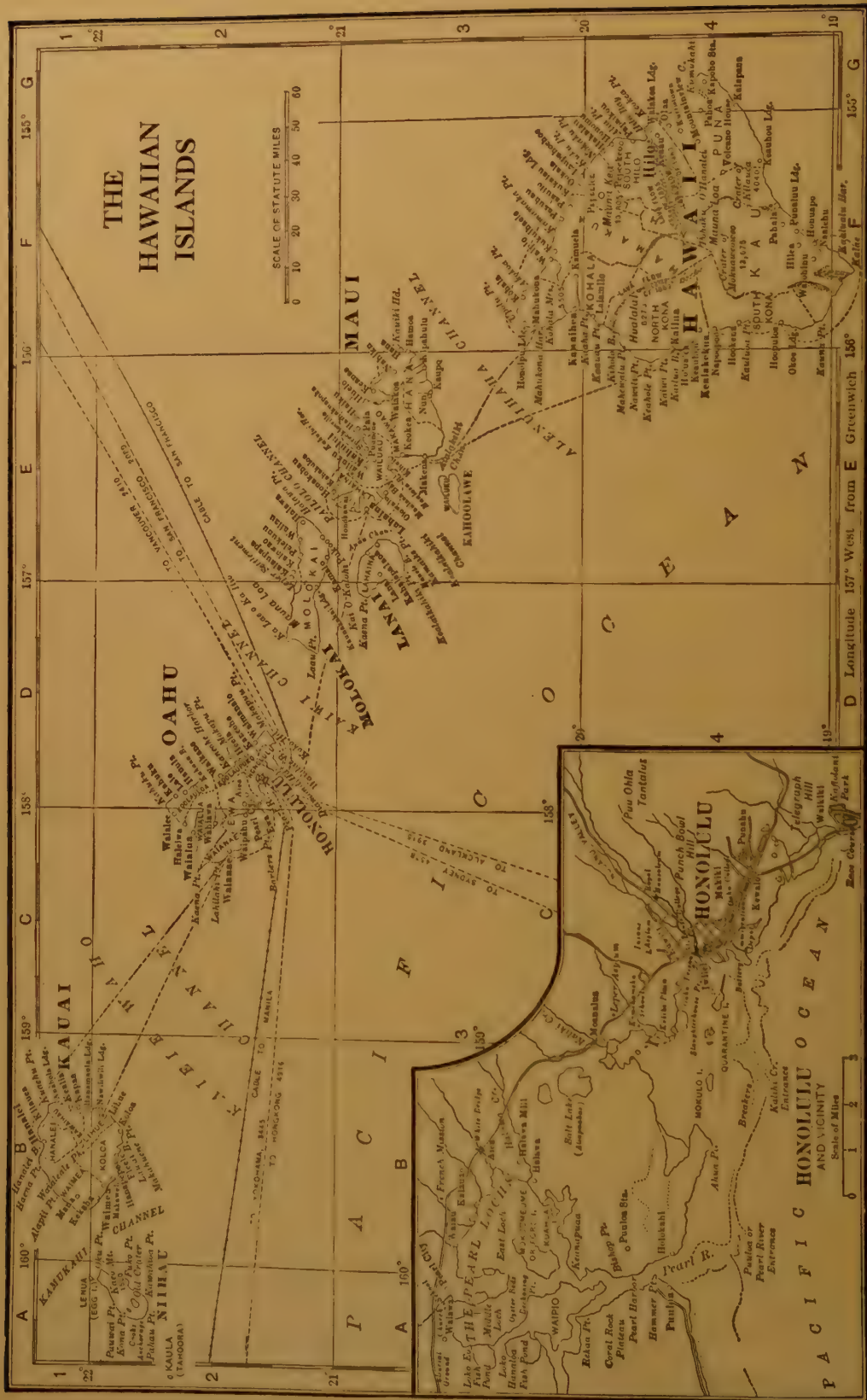
HAWAII: SCENES AND IMPRESSIONS

By K. F. Gerould

COMING HAWAII

By J. K. Goodrich

* * Information concerning the above mentioned books and articles may be had on application to the Editor of The Mentor.





EARTHQUAKES AND VOLCANOES

Earthquakes of the Old World

ONE

THE painstaking labors of many investigators during the past half century have made it possible to draw maps showing, in much detail, the extent to which every accessible part of the land area of our globe has been afflicted with earthquakes since the beginning of the historic records pertaining to each country. The results

prove Mother Nature to have been decidedly partial in her allotment of these visitations, which are almost commonplace in some regions and quite unknown in others.

In the eastern hemisphere there is a broad earthquake belt that stretches from the Azores, in an easterly to southeasterly direction, through the Mediterranean region, the Persian Gulf, northern India, Burma, and the East Indies; another which embraces Japan and the other islands east of the Asiatic continent; and a third extending from the Caspian Sea across Turkestan into the heart of Asia. Elsewhere in Europe and Asia earthquakes are of occasional occurrence, but over the greater part of Africa and Australia they are very rare. Italy and Japan are the notorious earthquake regions of the Old World.

Italian earthquakes of recent times have been attended by far greater loss of life than Japanese earthquakes, owing to the fact that Italian buildings are generally much less well adapted to withstand these shocks than Japanese buildings. In the last great Italian earthquake—the Avezzano disaster of January 13, 1915—the percentage of deaths was the highest ever recorded. Thus in the town of Capelle, 97 per cent. of the inhabitants perished. In the city of Avezzano the loss of life was 10,719, or about 96 per cent. of the total population. The number of persons instantly killed in the whole region of this earthquake was 29,978, as compared with

upward of 77,000 killed in the Messina disaster of 1908; but in Messina the fatalities amounted to only 65 per cent. of the population.

Japan has experienced something like 230 destructive earthquakes in the past 1,500 years, besides innumerable harmless shocks. No wonder this empire was the pioneer in the establishment of a national service for recording and studying earthquakes (organized in 1885). The Mino-Owari earthquake of October 28, 1891, shook an area of 243,000 square miles, or more than three-fifths of the entire area of Japan. "Without the least premonitory symptom," says Professor Hobbs, "the stroke fell, and in the first moment was wrought the destruction of about 7,000 people and 20,000 buildings, while 17,000 people were more or less seriously injured. As has been true of so many other earthquakes, fires almost immediately broke out among the ruins and burned to death many who might otherwise have escaped." Following the initial shock of this earthquake, no less than 2,588 aftershocks were registered on the local seismographs in the course of five months.

Probably the greatest of all earthquakes, though not the most destructive to life and property, was that which occurred in Assam, India, June 12, 1897. This earthquake is of special interest in the history of seismology as the first to be registered at a number of seismograph stations, including several in Europe.



SAN FRANCISCO, CALIFORNIA—CITY HALL AFTER THE EARTHQUAKE

EARTHQUAKES AND VOLCANOES

Earthquakes of the New World

TWO



HE western coast-line of both North and South America, like the long chain of islands fringing the eastern coast of Asia, is one of the great "seismic" belts of the globe. The majority of New World earthquakes occur in the regions adjacent to the Pacific Ocean, but there is another notorious earthquake zone encircling the Carib-

bean Sea. Chile is a famous earthquake country, and, like Japan, it has risen to the occasion and established one of the best-organized seismological services in the world, under the direction of an eminent French authority on earthquakes, Count de Montessus de Ballore. A destructive quake at Valparaiso in August, 1906, was largely responsible for the creation of this official service.

Locking the stable door after the horse has been stolen is a wise precaution—when one has other horses to protect. Just as the Chileans were literally shaken out of their lethargy with regard to the practical importance of seismological research by the Valparaiso disaster of 1906, so the people of the United States had their attention forcibly turned in the same direction by the calamity which overtook San Francisco a few months earlier: viz., in April, 1906. The most notable result of the San Francisco "fire" (as its victims euphemistically call it) was the immense stimulus it gave in this country to the study of earthquakes. The Seismological Society of America was founded soon afterward, and eventually the Government was induced to organize a national service for earthquake observations, under the control of the Weather Bureau.

Californians do not like to have attention called to the instability of their soil, and it is only fair to them to say that they are far indeed from having a monopoly of earthquakes in the United States. During the years 1811 and 1812 a remarkable series of shocks, now usually referred to as the "New Madrid earthquake," occurred in the middle Mississippi Valley. In the course of a few months no less than

1,874 shocks were recorded (by the human senses, not by seismographs, which were then unknown). Eight of these were very severe, and were felt more or less distinctly over the whole of the then settled portions of the United States. This earthquake produced notable geographic changes; new islands came into existence in the Mississippi, new lakes were formed in neighboring valleys (one of them 100 miles long), and old lakes disappeared. Strange to say, this earthquake is *still going on*; for slight aftershocks have been experienced in the same region almost every year since the original disturbance. The same persistence of aftershocks has been noted in connection with the disastrous Charleston, S. C., earthquake of August 31, 1886.

The Charleston earthquake was not a violent one, as earthquakes go, and would have attracted little attention if it had not happened in a large city. Few roofs or walls were thrown down. The greatest danger arose from the fall of brick chimneys, of which about 14,000 were demolished!

The whole of our Atlantic seaboard, from Nova Scotia to Georgia, is a potential seat of earthquakes, the instability of the earth being perhaps especially marked along the break or fault in the earth's crust known as the Fall Line, which passes close to Boston, New Haven, New York, Trenton, Philadelphia, Wilmington, Baltimore and Washington. Light shocks are not infrequent in this zone, but the fact that no destructive quake has yet occurred is reassuring. On the whole, however, the United States can hardly be called an "earthquake country."



SEISMOGRAPH—BOSCH TYPE

EARTHQUAKES AND VOLCANOES

The Study of Earthquakes

THREE

IN December, 1857, the greater part of southern Italy was shaken by an earthquake, and in a district not far from Naples this disturbance cost more than 12,000 lives. An Irish engineer, Robert Mallet, who had long been a student of earthquakes, received from the Royal Society of London a grant which enabled him to proceed

to the scene of the disaster, and make elaborate investigations of its effects, especially upon buildings. As a result he published a bulky report, in two volumes, entitled "The Great Neapolitan Earthquake of 1857," since regarded as a scientific classic, and the first great contribution to the modern science of seismology.

Mallet accepted certain time-honored ideas concerning the subterranean features of the earth that have since been proved to be erroneous, but some of the conceptions and terms he introduced have endured to the present day. In mapping earthquakes, Mallet and subsequent seismologists have followed the plan of indicating a spot, called the *epicenter*, which is supposed to lie directly over the underground focus of the disturbance and to be at or near the center of the region in which the earthquake is most severely felt at the surface. Surrounding this spot are drawn several curved lines, known as *isoseismals*, connecting points at which the shock is believed to have been felt with equal intensity. Each of these lines represents a certain degree of violence on an "earthquake scale." The Rossi-Forel scale has been more widely used than any other. There are ten degrees in this scale, ranging from No. 1, the feeblest shock perceptible to an experienced observer, up to No. 10, defined as "shock of extreme intensity; great disaster; buildings ruined; disturbance of strata, fissures in the ground, rock-falls from mountains."

While Mallet was the first to make a thorough scientific study of the mechanism of an earthquake, the organization of earthquake observations over an extensive

area, constituting what may be called an "earthquake survey," was first successfully carried out in Japan, under the direction of an Englishman, John Milne. Native scientists also took up the work in that country, and today some of the foremost seismologists in the world are Japanese.

Nearly all civilized countries now have official or unofficial seismological services on a national scale. In each service there are several stations equipped with delicate instruments, called *seismographs*, which make automatic records of all quakes, including a large percentage that are quite imperceptible to the senses; but the majority of observers have no instruments and merely send in reports of the sensible shocks and their effects. In the United States work of this kind is carried on under the general supervision of the Weather Bureau, with headquarters in Washington, but there are many unofficial seismograph stations, at educational institutions and elsewhere.

Seismological investigations have a twofold value. First, they contribute to our knowledge of the earth's structure and throw light upon many problems in geology. Second, they conduce directly to human welfare, by showing just where the earth's crust is so unstable that special precautions need to be taken in the construction of dams, irrigation channels, aqueducts, bridges, and buildings of all kinds. Moreover, a careful study of the effects of earthquakes furnishes to engineers and architects valuable information concerning methods of construction and kinds of material best adapted to resist earthquake shocks.



EARTHQUAKES AND VOLCANOES

Old World Volcanoes in Action

FOUR



AMONG natural phenomena there are two which are so spectacular that the impression they produce upon the beholder remains vivid for a lifetime. One of these is a total eclipse of the sun, and the other is a violent volcanic eruption. To obtain a sight of a total solar eclipse is comparatively easy, since the precise dates

and places of occurrence of these phenomena are known for years and centuries in advance. Unfortunately this is not true of volcanic eruptions. Hence, getting a view of one of the latter at the height of its activity is purely a question of luck, and there are many professional volcanologists who have never enjoyed this privilege.

The most stupendous eruption of modern times was that of Krakatoa, in the Dutch East Indies, in August, 1883. The Strait of Sunda, in which this volcano is situated, is one of the most frequented of ocean highways, and many vessels were passing through the strait at the time of the eruption. Even at a distance of scores of miles the sights and sounds were appalling beyond description. The explosions hurled dust and ashes to a height of seventeen miles, and some of this material was showered down, three days after the eruption, upon ships 1,600 miles away. Sounds of the eruption, like the roar of distant heavy guns, were heard at Rodriguez Island, in the Indian Ocean, nearly 3,000 miles from the volcano. The air-waves produced by the eruption traveled round the whole globe, not only once, but several times, as shown by the automatic records of barometric pressure made at observatories. Water-waves, hurled upon adjacent shores, overwhelmed 1,295 villages and drowned 35,000 people.

The archipelago in which Krakatoa is situated is the greatest focus of volcanic

activity on the globe, but it has a close rival in the island empire of Japan, which possesses 54 active or recently active volcanoes. The late Professor Milne collected records of 233 eruptions in Japan, from the earliest historic times down to the year 1886. The "sacred mountain," Fuji-San, owes its graceful contour to the fact that it is a volcanic cone, and it is said to have risen from the plain in a single night in the year 285 B. C. Its last eruption occurred during the winter of 1707-1708. Asama-Yama, Japan's largest active volcano, was the scene of a stupendous explosive eruption in 1783. The terrific eruption of Bandai-San, in 1888, which blew away the greater part of a mountain 2,000 feet high, was remarkable for the fact that no lava was discharged. The volcanic island of Sakura-Jima, opposite the city of Kagoshima, was the seat of an immense eruption in January, 1914. In this case the premonitory signs of activity led to the timely evacuation of the island by its 23,000 inhabitants, and there was little loss of life.

On the mainland of Europe there is only one active volcano, Vesuvius; but there are several in the islands of the Mediterranean, the most famous being Etna (Ætna), in Sicily, and Stromboli, one of the Lipari Islands. The glow over Stromboli is always visible by night, so that this mountain serves as a lighthouse to the sailors of the Mediterranean.



RUINS OF ST. PIERRE, MARTINIQUE—AFTER THE ERUPTION OF MONT PELÉ

HOW proud we were, in school days, of our ability to pronounce glibly the names of Jorullo and Popocatepetl! and how enduringly the school geographies impressed upon our minds the story of the sudden apparition of the former and the picture of Indians gathering sulphur from the crater of the latter! And giant

Orizaba, presenting on its slopes every climatic stage, from tropical jungles at the base to eternal snows at the summit, with an occasional canopy of hot vapors overhead to complete the paradox—how the name carries us back!

These Mexican volcanoes are part of a fiery chain that stretches from the southern tip of South America northward along the Andes and the western coast and mountains of North America, to Alaska, where the Aleutian Islands, studded with active craters, carry the chain across to the volcanic belt that fringes the western shores of the Pacific.

Though this line of volcanoes traverses the United States and includes some imposing volcanic cones, such as Mounts Shasta, Hood and Rainier, the fires of nearly all of these mountains within our own territory seem to be quite burned out. Hence it was a sensational event, when, on May 30, 1914, Lassen Peak, in northeastern California, began a long period of activity, which provided, among other things, an interesting "side show" in connection with the California expositions of the following year. During the years 1914 and 1915 there were 220 eruptions of this volcano, and there have been many since. In the middle of 1915 the crater began to emit lava, and some of the eruptions by night during that year were decidedly spectacular. A tract of land which includes this volcano has recently been set aside by the Government as the Lassen Volcanic National Park.

To make amends for the scarcity of active volcanoes within the United States proper, Nature has provided a liberal supply of them in Alaska, and a few of remarkable interest in the Hawaiian Islands.

The eruption of Mount Katmai, Alaska, in June, 1912, was one of the greatest that has occurred anywhere in the world. The mass of ash and pumice thrown into the air is said to have amounted to five cubic miles, and in its fall it buried an area as large as the State of Connecticut to a depth of from ten inches to ten feet. Professor R. F. Griggs, who has led two expeditions to investigate the scene of this erup-

tion, says of it: "The magnitude of the eruption can perhaps be best realized if one could imagine a similar outburst centered in New York City. All of Greater New York would be buried under from ten to fifteen feet of ash; Philadelphia would be covered by a foot of gray ash, and would be in total darkness for sixty hours; Washington and Buffalo would receive a quarter of an inch of ash, with a shorter period of darkness. The sound of the explosion would be heard in Atlanta and St. Louis, and the fumes noticed as far away as Denver, San Antonio and Jamaica."

A striking contrast to this tremendous explosion is afforded by the generally tranquil but continuous eruptions of the famous volcanoes in Hawaii. Dr. T. A. Jaggar, Jr., director of the Hawaiian Volcano Observatory, writes: "The Hawaiian volcanoes are truly a national asset, wholly unique of their kind, the most famous in the world of science and the most continuously, variously, and harmlessly active volcanoes on the earth. Kilauea crater has been nearly continuously active with a lake or lakes of molten lava for a century; Mauna Loa is the largest active volcano and mountain mass in the world, with eruptions about once a decade, and has poured out more lava during the last century than any other volcano on the globe. Haleakala is a mountain mass 10,000 feet high, with a tremendous rift in its summit eight miles in diameter and 3,000 feet deep, with many high lava cones built up inside the crater. It is probably the largest of all known craters among volcanoes that are technically known as active. Haleakala erupted less than 200 years ago. The crater at sunrise is the grandest volcanic spectacle on earth."

The Lesser Antilles, in the West Indies, constitute another important area of volcanic activity in the New World. It was in the island of Martinique, in this group, that occurred in 1902 the frightful eruption of Mont Pelé, which killed instantly all but two of the 30,000 inhabitants of the neighboring city of St. Pierre.



EARTHQUAKES AND VOLCANOES

The Study of Volcanoes

SIX

DOUTBLES it would be stretching the language a bit to refer to the elder Pliny, the most learned Roman of his time, as a "volcanologist," yet the fact that we are most likely to remember about that distinguished philosopher is that he perished in gratifying his desire to examine an active volcano at close range. He was a

victim of the same eruption of Vesuvius, in A. D. 79, which buried the cities of Pompeii and Herculaneum. A vivid account of his death has been left us by his nephew, Pliny the Younger.

Modern students of volcanoes not infrequently take their lives in their hands and venture into the very jaws of the treacherous monsters whose habits it is their business to investigate. Several daring descents have thus been made into the crater of Vesuvius, for the purpose of taking photographs, measuring temperatures, and collecting specimens of volcanic material. The huge crater of Kilauea, in the Hawaiian Islands, has furnished a congenial field of research for several generations of volcanologists. An early student of this volcano, Dr. Judd, came near perishing in the lava pit of this volcano in 1841. "At that time," says Dr. G. Hartwig, "the smallest of the two lava pools which boil at the bottom of that extraordinary pit appeared almost inactive, giving out only vapors, with an occasional jet of lava at its center. Dr. Judd, considering the quiet favorable for dipping up some of the liquid with an iron ladle, descended for the purpose to a narrow ledge bordering the pool. While he was preparing to carry out his idea, his attention was excited by a sudden sinking of its surface; the next instant it began to rise, and then followed an explosion, throwing the lava

higher than his head. He had scarcely escaped from his dangerous situation, the moment after, by the aid of a native, before the lava boiled up, covered the place where he had stood, and, flowing out over the northern side, extended in a stream a mile wide to a distance of more than a mile and a half." Similar adventures have fallen to the lot of subsequent investigators, including Dr. T. A. Jaggar, Jr., now in charge of the observatory on Kilauea maintained by the Hawaiian Volcano Research Association, the scientific work being under the direction of the Massachusetts Institute of Technology. A continuous record is kept here on the varying level of the lava lake which may always be seen in the pit of Halemaumau; sometimes lying hundreds of feet below its margin, and at other times filling it nearly to the top. The temperature of the lava is measured by lowering into it fusible plugs, having various known melting-points.

Occasional descents are made into the pit for the sake of carrying out special investigations. The lake has a temperature of about 1800 degrees Fahrenheit, and its surface is generally covered by a thin skin of solidified lava, broken here and there by "fountains" of the fiery fluid. Over this hot crust, their faces protected by gas-masks from the stifling fumes, the investigators cautiously make their way.